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(54) A process control data processing apparatus

(57) A process control data processing apparatus has a database controller (20) with various components (34 - 39) constructed for real-time reception of process control data, processes being initiated upon reception of upload data via an upload input interface (30). Various data structures are used including an input file structure (26) having data records and separate sections, process files (27) and a history file (24). Input file data are verified by a verifier (32). A process control interface (37) writes in parallel to both process files (27) and an input file (26), updating of the history file (24) being via the input file (26) for vast data retrieval and data integrity. The history file (24) provides fast data access via a read-only bus (22) and a data filter (21).

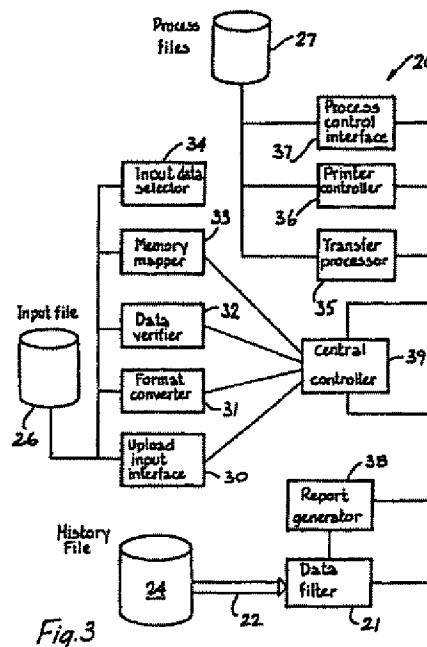


Fig.3

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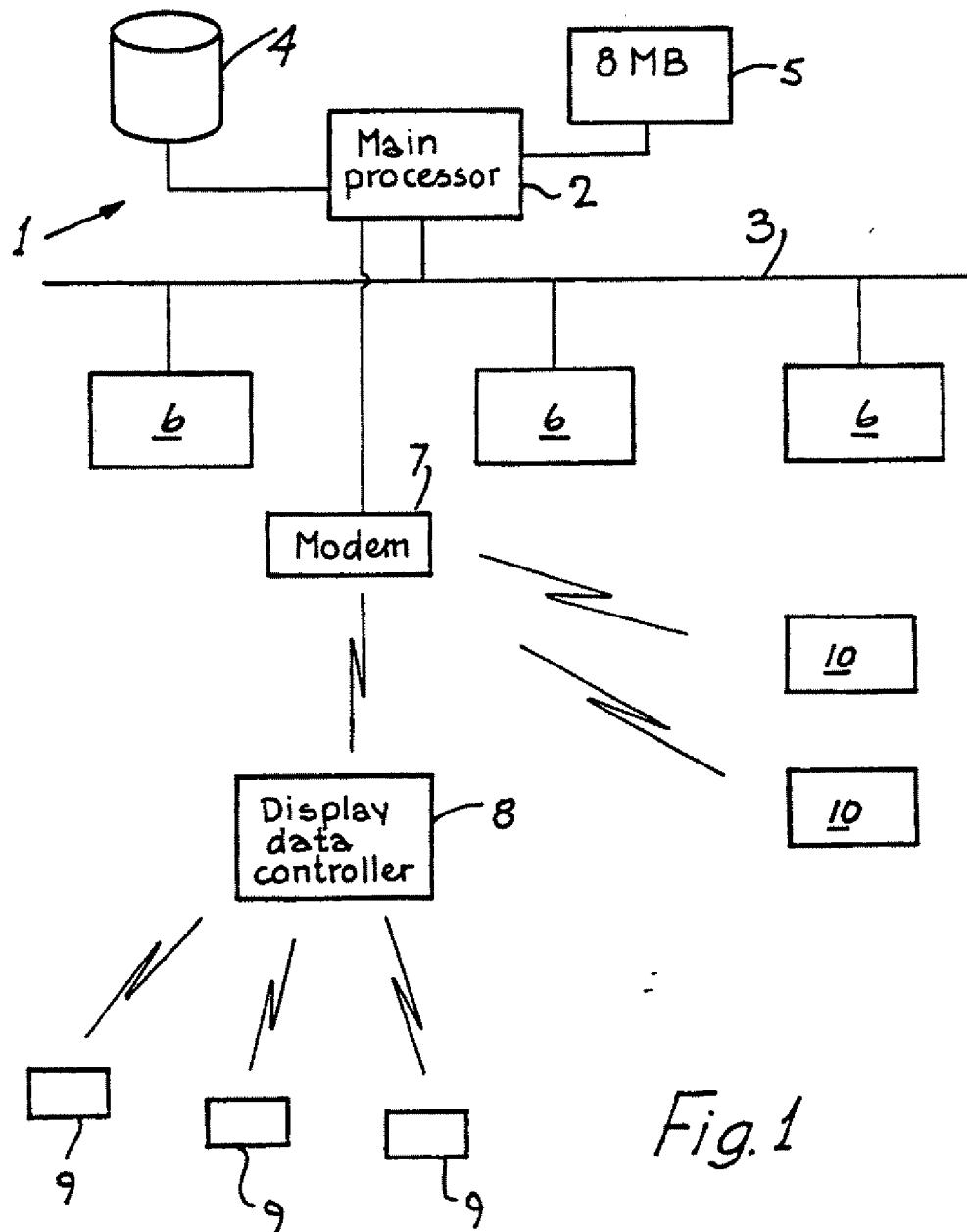


Fig. 1

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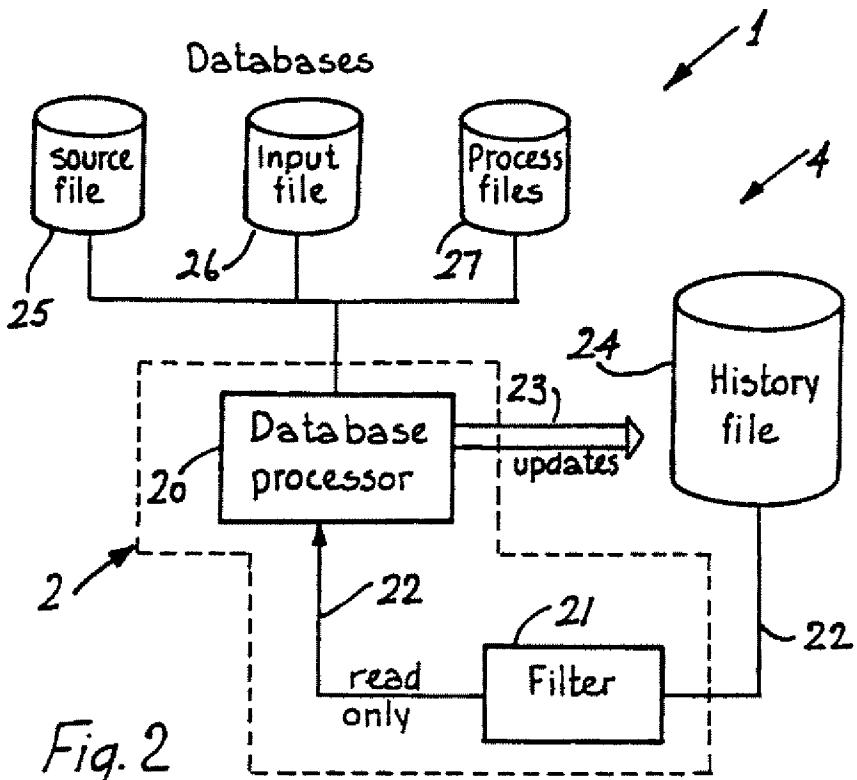


Fig. 2

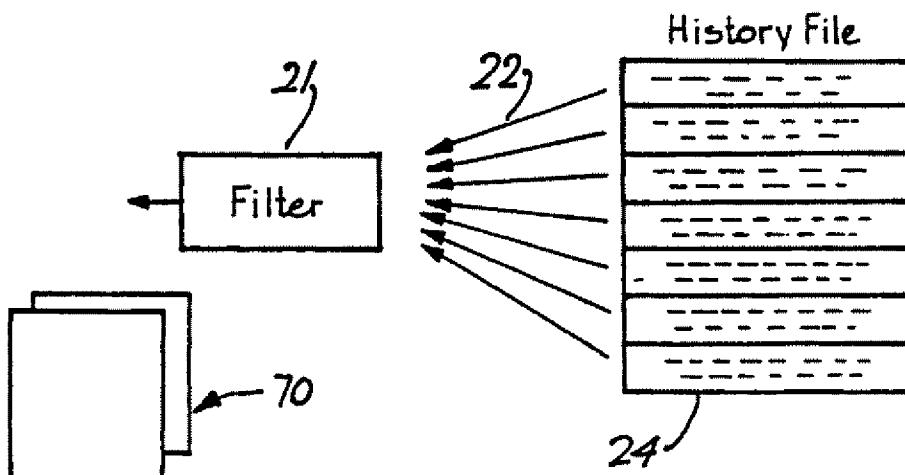


Fig. 6

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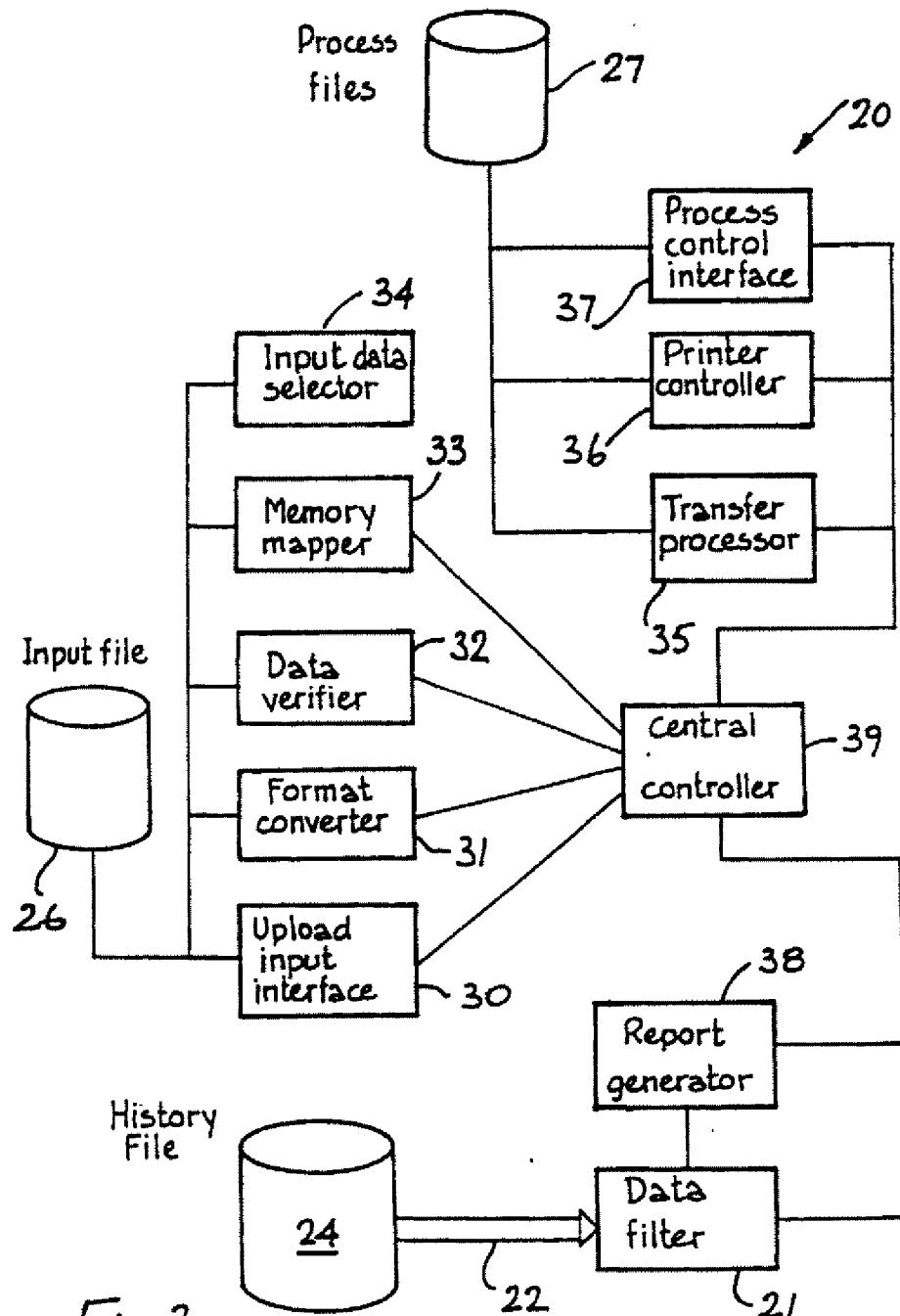


Fig.3

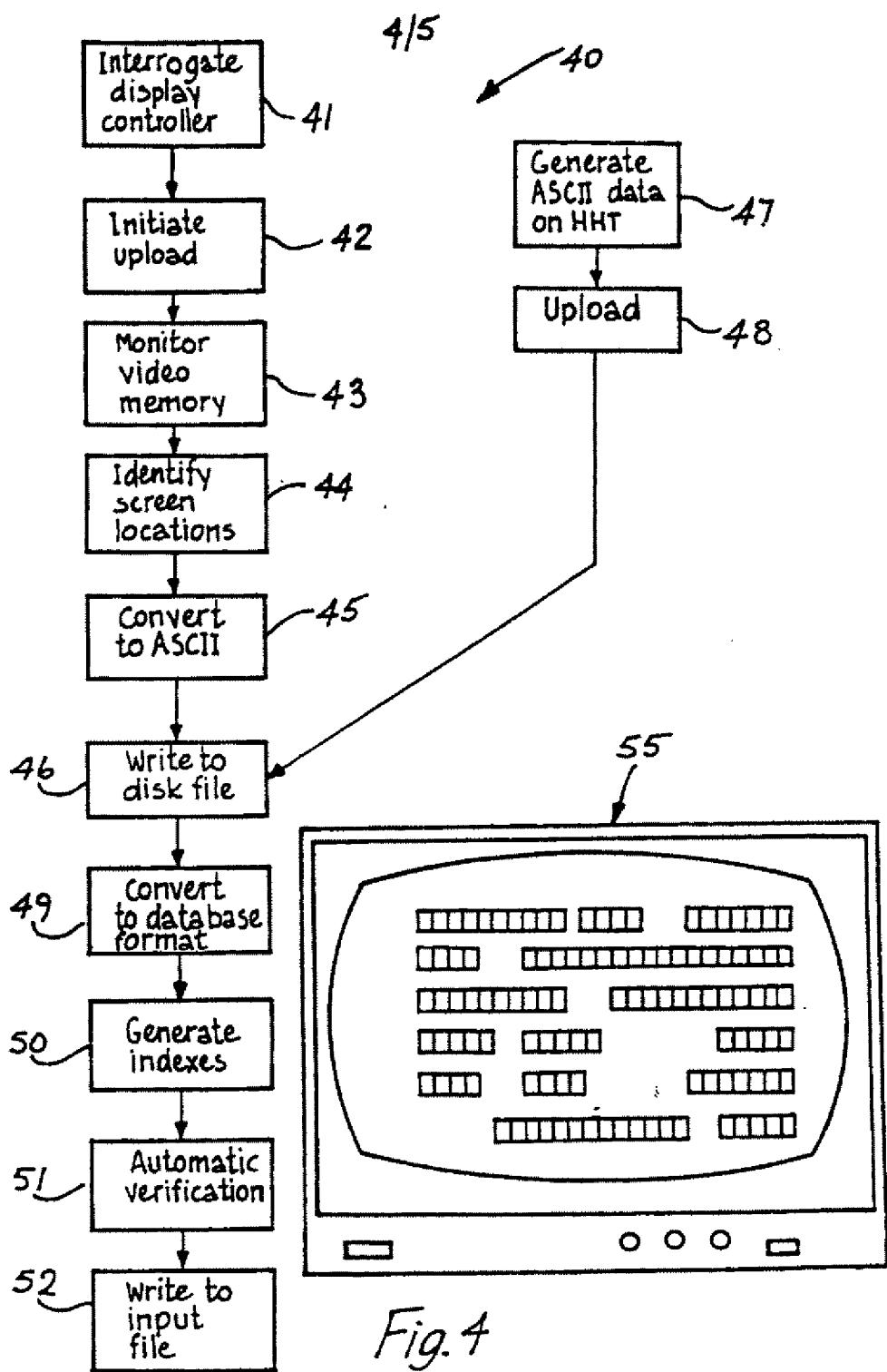
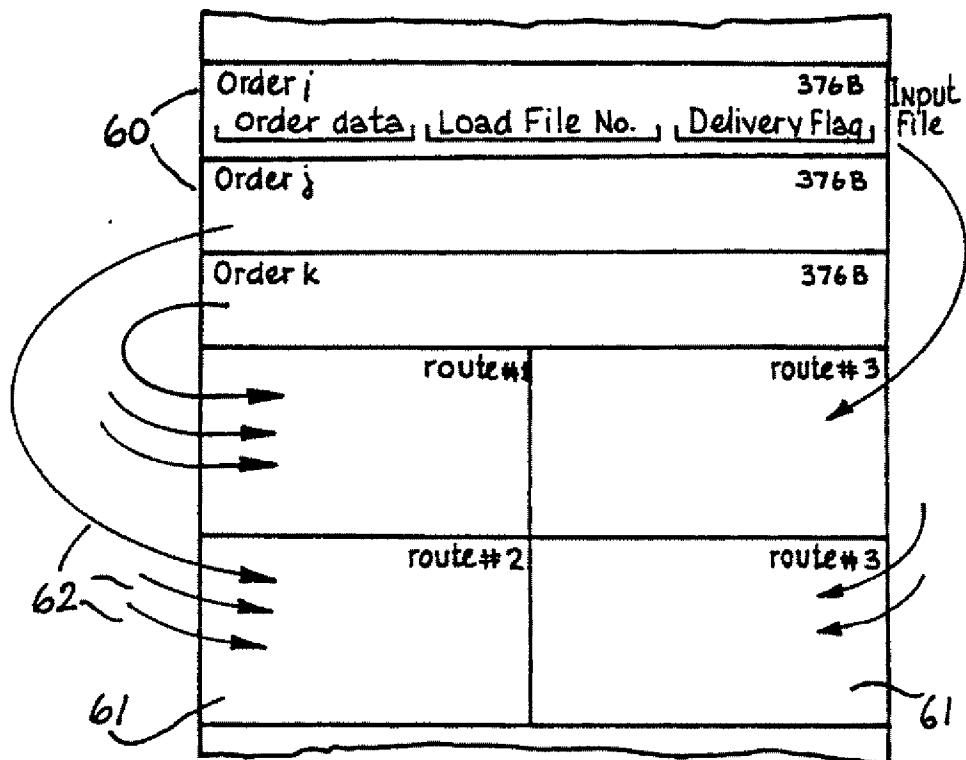


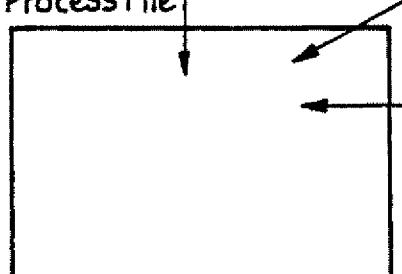
Fig. 4

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26



Process File



Process Flag
Inputs

27

Fig. 5

"A process control data processing apparatus"

The invention relates to a data processing apparatus for use in process control. In particular, the invention relates to such an apparatus where there are a very large number of physical items or units involved in the process 5 control wherein action and/or movement of these units must be tracked.

In such a process control situation, it is very important that data relating to each of the process control units be received, processed and outputted on a real-time basis. 10 If this is not the case, then it would not be possible to generate output control signals such as those directing printing of process control documents in a timely manner to ensure effective process control. It is also desirable for such an apparatus to retrieve with a fast response 15 time historical data relating to process control of units in the past. If the data processing is not carried out in real time, then major delays and inefficiencies will arise in the physical process. If there is not fast and comprehensive access to historical data relating to 20 process, then it is extremely difficult to plan for the future. An example is in chemical process control where various sensors are connected to the data processor which processes the received data and generates output signals controlling equipment for manufacture of a chemical 25 compound. Real-time operation is extremely important and it is absolutely essential to be able to access historical data relating to batches of compounds produced in the past, particularly for pharmaceutical use.

British Patent Specification No. GB-B-2194655 (Rolls 30 Royce) describes a data processing apparatus capable of real-time operation. In this apparatus, there are several interconnected microprocessors which provide the necessary

real-time responses. In this apparatus, however, there is no disclosure of circuits for fast and comprehensive retrieval of historical data.

- 5 In general, the tendency in the past has been to provide extremely large and complex processor systems in order to provide real-time responses and a very fast response time for large numbers of data items. For many businesses, it is not practical to install and operate such large systems.
- 10 The invention is directly towards providing a process control data processing apparatus to overcome these problems.

According to the invention, there is provided a process control data processing apparatus comprising:-

- 15 a pre-defined input file structure stored on a database;
- 20 an upload input interface comprising means for receiving data from different sources and writing the data in the format of records in the input file structure;
- 25 a format converter for automatically converting data in the input record to a pre-defined database format;
- 30 a data verifier for automatically verifying data in the input file;
- 35 a memory mapper for mapping sections comprising sets of locations of the input file, each to be associated with a category of input data;

an input data selector comprising means for identifying the category of each input data record and writing data from pre-set fields to the associated mapped input file section;

5 pre-stored process file structures stored on a storage device;

10 a transfer processor comprising means for transferring data from the mapped sections of the input file to the process files according to the data category and for automatically writing a process file indicator to the relevant input data records;

a printer controller comprising means for directing printing of a process document associated with each process file;

15 a process control input interface comprising means for receiving process control input signals and for automatically writing process control data to the input data records;

20 a pre-stored history file structure stored on a storage device;

means in the transfer processor for automatically transferring input data records to the history file according to the stored process data;

25 a read-only bus connected to the history file structure;

a data filter; and

a report generator comprising means for activation of the data filter for retrieval and filtering of history file data according to interactively inputting filtering criterion.

- 5 Preferably, the upload input interface comprises means for monitoring serial pixel data according to screen location and automatically generating compatible format data for storage on a storage device, monitoring of the pixel stream and reference to pre-set character start and string length indicators.
- 10

In one embodiment, the format converter comprises means for generating indexes when the data has been written by the format converter to the pre-defined database format.

- 15 In another embodiment, the input data selector comprises means for interfacing with a user for interactive editing of the input file sections.

Ideally, the apparatus further comprises a source file for storage of data relating to sources of data and the printer controller comprises means for referring to the source file for generation of process control documents.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings, in which:-

- 25 Fig. 1 is a schematic representation of a process control apparatus and other systems for inputting of data to the apparatus;

Fig. 2 is a schematic representation of the apparatus in more detail;

Fig. 3 is a diagram showing the apparatus in still further detail;

5 Fig. 4 is a flow chart and a diagrammatic representation of a screen showing the manner in which the apparatus operates;

Fig. 5 is a diagram showing file structures of the apparatus; and

Fig. 6 is a data flow diagram showing retrieval of historical data.

10 Fig. 1 shows a process control data processing apparatus 1 which comprises a main processor 2 having at least one Intel 486" microprocessor connected on a local area network 3. The main processor 2 is connected to a set of storage devices having a capacity in excess of 100 MB and being indicated generally by the reference numeral 4. A random access memory 5 having a capacity of 8 MB is connected directly to the main processor 2. Various auxiliary processors 6 are connected to the network 3 and a modem 7 is connected directly to the main processor 2.

20 The process control data processing apparatus 1 is connectable to various remote systems such as a display data controller 8, in turn connectable to a set of slave terminals 9. There is also a large number of hand-held terminals (HHT's) 10 which are connectable to the apparatus 1 via the modem 7.

25 In more detail and referring to Fig. 2, the storage devices 4 store a pre-defined source file structure containing fixed data relating to sources of process control input data. These sources are the people or

companies operating the various slave terminals 9 and the hand-held terminals 10. There is also a pre-defined structure for an input file 26 for the inputting of data received from the sources and there are a number of process files 27, each relating to various processes to be carried out under the instruction of the apparatus 1. Finally, there is a pre-defined structure for a history file 24. The main processor 2 comprises a database processor 20 connected to a digital filter 21. The filter 21 is connected between the history file structure 24 and the database processor 20 by read-only data buses 22. The data processor 20 is connected to the history file structure 24 via an update data bus 23.

In still further detail, and referring to Fig. 3, the database processor 20 comprises various sub-components which may be implemented as individual hardware circuits or as software modules operating one or more hardware circuits. These components comprise an upload input interface 30, a format converter 31, a data verifier 32, a memory mapper 33 and an input data selector 34, all of which are connected between a central controller 39 and the input file structure 26. Further, the database controller 20 comprises a transfer processor 35, a printer controller 36, and a process control interface 37, all of which are connected between the central controller 39 and the process files 27. These components are also connected to various other parts of the system 1 including printers and display devices where the process is the storage and delivery of goods. The components may also be connected to various other devices such as heaters and valves in a chemical production process plant. For generation of long-term process control information, the controller 20 comprises the data filter 21, previously referred to, and a report generator 38 connected via the read-only data bus

22 to the history file structure 24. Again, various other components such as printers are not shown in this diagram.

- Operation of the apparatus 1 is now described with reference to Figs. 4, 5 and 6. The upload input interface 30 is constructed for controlling the uploaded information from the various sources via the slave terminals 9 and the hand-held terminals 10. This is a very important function as it is essential that data be uploaded in an efficient and comprehensive manner with data integrity. The upload input interface 30 in step 41 interrogates the display data controller 8 to detect storage of upload data received from the slave terminals 9. The slave terminals 9 do not include storage devices and operate on the principle of displaying data in pre-defined screen formats. This allows ease and accuracy of inputting by non-computer literate people. The display data controller 8 stores the data in this screen format and the interface 30 initiates an upload in step 42 via the modem 7. Another function of the upload input interface 30 is that it automatically monitors pre-set character positions of screens in the uploaded data and stores a pre-defined series of pixel control signals relating to these portions of the screen as upload data. Identification of the screen location involves specifying rows for screen display, starting characters, and string lengths. This is illustrated diagrammatically in Fig. 4 on a display device 55. The interface 30 converts the pixel data to ASCII format and writes the ASCII format data to a directory file in steps 43 to 46.
- The input interface 30 also monitors input ports for reception of ASCII data from hand-held terminals 10 in step 47 and writes it to memory in step 48 before it is written in step 46 to a disk file. The format converter 31 is automatically activated to convert the data to a

database format and to generate database indexes in steps 49 and 50 before automatic verification of the data by the data verifier 32. Verification involves comparisons with stored reference data. The data verifier 32 also writes 5 the data from each source to an individual record on the input file 26. Thus, at the end of an upload session there may be up to 100 or more input records stored on the input file 26, the data being in the correct database format and being verified.

10 Referring in particular to Fig. 5, the memory mapper 33 retrieves a particular category of input data which may be a route for delivery of goods where the input data relates to an order for goods. For each category of data, the memory mapper 33 generates a section of the input file 26 indicated by the numeral 61 in Fig. 5. The input data records are indicated by the numeral 60. As indicated in 15 Fig. 5, each input file record includes for the above-mentioned example, order data, a load file number and a delivery flag. More generally, this data relates to process data, process category data and process status data. For clarity, the example where the process is delivery of goods will be referred to. The input data selector 34 automatically operates to retrieve from the records 60 all data associated with each mapped section of 20 the input file 26 and this is indicated by the data transfer paths 62. Interactive editing of the section 61 may then be carried out to benefit from user direct inputs.

25 The transfer processor 35 then comes into operation to 30 write data from the sections 61 to one or more process files 27. For example, one process file may relate to delivery of goods with a single lorry in a single day. Such operation may involve different routes and therefore,

there is an many-to-one relationship between the sections
61 and the process files 27.

The printer controller 36 comes into operation to generate
process control documents from each of the process files
5 27 to help control the carrying out of the processes. An
example is printing of a load sheet for delivery of goods,
the printing of instructions for control of a batch
reactor, etc. The process control interface 37 operates
to receive on a real-time basis inputs relating to the
10 status of the various processes. This is achieved by
writing of flags to both the process files 27 and to the
input records 60. This is a very important aspect of the
invention in that it helps not only in process control but
also in retrieval of data for off-line processing at a
15 later stage.

Referring again to Fig. 2, the database processor 20 in a
batch process updates the history file by direct writing
of the input data records 60 to the history file 24,
provided the process flags have a certain value. In the
20 goods delivery example, the process flag may be a delivery
flag to indicate whether the goods have been delivered,
returned or have not yet been put on route. In this
example, the data will be written to the history file 24
for all records where the goods have been delivered. This
25 allows writing over of those portions of the input file 26
occupied by these data records.

Another important technical aspect of the invention is the
manner in which the read-only data bus 22 is used for
retrieval of data from the history file 24 and filtering
30 by the filter 21 so that the report generator 38 may
generate reports 70 indicating historical performance of
the various processes.

It has been found that the structures whereby data is stored and the construction of the database controller 20 lead to the ability for reception of real-time inputs via the process control interface 37 and the real-time accessing of data in the process files 27 and in the input file 26. There is thus a dual-mode for storage of the data to provide versatility in data retrieval and output via the central controller 39 which accesses all of the files via the various components of the database controller 20. It has been found that a response time of milliseconds can be achieved with retrieval of data for generation of reports relating to previous processes. This is extremely important in planning for the future.

It will be appreciated that the invention provides the technical features necessary to achieve real-time process control with a fast response time for both on-line and off-line data retrieval.

The invention is not limited to the embodiments hereinbefore described, but may be varied in construction and detail.

CLAIMS

1. A process control data processing apparatus comprising:-

5 a pre-defined input file structure stored on a database;

an upload input interface comprising means for receiving data from different sources and writing the data in the format of records in the input file structure;

10 a format converter for automatically converting data in the input record to a pre-defined database format;

a data verifier for automatically verifying data in the input file;

15 a memory mapper for mapping sections comprising sets of locations of the input file, each to be associated with a category of input data;

20 an input data selector comprising means for identifying the category of each input data record and writing data from pre-set fields to the associated mapped input file section;

pre-stored process file structures stored on a storage device;

25 a transfer processor comprising means for transferring data from the mapped sections of the input file to the process files according to the data category and for automatically writing

- a process file indicator to the relevant input
data records;
- 5 a printer controller comprising means for
 directing printing of a process document
 associated with each process file;
- 10 a process control input interface comprising
 means for receiving process control input
 signals and for automatically writing process
 control data to the input data records;
- 15 a pre-stored history file structure stored on a
 storage device;
- means in the transfer processor for
 automatically transferring input data records to
 the history file according to the stored process
 data;
- a read-only bus connected to the history file
 structure;
- a data filter; and
- 20 a report generator comprising means for
 activation of the data filter for retrieval and
 filtering of history file data according to
 interactively inputting filtering criterion.
- 25 2. An apparatus as claimed in claim 1, wherein the
 upload input interface comprises means for monitoring
 serial pixel data according to screen location and
 automatically generating compatible format data for
 storage on a storage device, monitoring of the pixel

stream and reference to pre-set character start and string length indicators.

3. An apparatus as claimed in claims 1 or 2, wherein the
5 format converter comprises means for generating indexes when the data has been written by the format converter to the pre-defined database format.

4. An apparatus as claimed in any preceding claim,
10 wherein the input data selector comprises means for interfacing with a user for interactive editing of the input file sections.

5. An apparatus as claimed in any preceding claim,
further comprising a source file for storage of data relating to sources of data and the printer controller comprises means for referring to the
15 source file for generation of process control documents.

6. An apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

CRUICKSHANK & CO.,